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AUTHOR Autrey, Kathy R.; Horton, Steve; Kher, Neelam; Molstead, Susan; Juneau, Gayle

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ABSTRACT

This study examined college students' proneness to dropping out, focusing on student success in developmental mathematics. The study investigated whether or not three groups of college freshmen taking developmental mathematics (completers, grade C or better; nonsuccessful completers, grade D or F; and noncompleters, grade W) were significantly different in terms of dropout proneness scores on the College Student Inventory, which was designed for incoming freshmen and included 194 items that focused on academic motivation, social motivation, general coping skills, receptivity to support services, and initial impression. The dropout proneness scale measured students' overall inclination to drop out prior to completion of a degree plan. The inventory was administered to incoming freshmen (n=402) enrolled in a development mathematics for the fall 1996 semester, either during a summer freshman program or during fall orientation. Only students who had completed the College Student Inventory were included in the sample. Researchers collected demographic data and college course grades from the student information system. Results highlighted statistically significant differences between successful completers and nonsuccessful completers on the dropout proneness score. Nonsuccessful completers had higher dropout proneness than successful completers. There were no statistically significant differences between noncompleters and nonsuccessful completers. (Contains 24 references.) (SM)

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DIFFERENCES IN DROPOUT PRONENESS SCORES OF THREE GROUPS OF COLLEGE STUDENTS

Kathy R. Autrey
Steve Horton
Neelam Kher
Susan Molstead
Northwestern State University
Natchitoches, Louisiana

Gayle Juneau
University of West Florida

Paper presented at the Twenty-eight Annual Meeting of the Mid-South Educational Research Association
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Rationale

One of the major problems facing colleges and universities nationwide is a high attrition rate; approximately 57% of the students entering a college or university in 1986 left without receiving a degree. Of those leaving, 75% left higher education altogether. The consequences of this exodus are not trivial for either the students or higher education in general. Individuals leaving the system forfeit the occupational, monetary and other societal rewards associated with having a degree. The colleges and universities suffer the effects of declining enrollments (Tinto, 1987a). While studies have indicated a number of factors that can be linked to a high attrition rate, academic underpreparation is definitely one of the most prevalent factors identified; 59% of the enrollees in 1995 at Prince George's Community College required remediation on 1 of 3 placement tests. Only 15% of the students taking remedial courses completed all of the required programs (Boughan, 1995; Feldman, 1993; Mohammadi, 1994).

The end result of aggressive affirmative actions designed to increase enrollment at colleges and universities coupled with open enrollment policies has been a high ratio of "high risk" students. Admission of these students almost guarantees the college or university will suffer from declining enrollments. At Northwestern State University in Natchitoches, Louisiana, for example, 73% of entering freshmen in 1992 exhibited one or more of the characteristics identified with "high risk" students; Northwestern's dropout rate was approximately 50% between the freshmen and sophomore years of study (Strengthening student services and comprehensive developmental education, 1994). These statistics give support to the contention that a student population that is largely under-prepared for college study will be unable to adjust to the demands of the higher education system.

Efforts to meet the needs of this underprepared population have been similar at most universities and community colleges across the nation; remedial programs in the areas of English, mathematics and reading have been designed to assist the underprepared student succeed (Roueche & Kirk, 1977). Successful remediation efforts are designed to ensure the continued survival of the university (Cross, 1971; Roueche & Kirk, 1977). While high attrition from these programs still remains a problem, evidence suggests that remedial programs can indeed be successful in preparing students for a college level program of study (Boylan, 1983; Hector, 1983; Richards, 1986).

Typically, universities and community colleges offer remedial coursework in English, mathematics and reading. According to McCoy (1991), of the entering freshmen in all Maryland public colleges and universities, 40% required remedial reading, 33% remedial English and 40% remedial math. Between 1975 and 1980, demand for remedial math courses in public 4 year colleges increased by 72% and these courses now constitute one-fourth of all math courses taught at those institutions ("A Nation at Risk," 1983).

Remedial math in general. Developmental or remedial math generally involves material that would normally be covered in junior high school and high school courses; the course content tends to vary from institution to institution since a general definition of developmental or remedial math has not been agreed upon (Dr. Leslie

Murray, personal communication, August 16, 1997). Usually, students must pass these courses with a grade of "C" or better in order to progress to the first college level math course required at the college or university.

The student's ACT score may be used to determine placement into these courses; at Northwestern State University, for example, a score of 15 - 18 places a student in Math 0920. A score below 15 places the student into Math 0910. Students who feel that the ACT does not adequately reflect their knowledge may take the math placement exam. This test, developed by the American Mathematical Association (AMA), is given during the summer and at the beginning of each regular semester. A score below 50% places a student in Math 0910; a score from 51% to 75% places a student in Math 0920. The use of ACT scores and other placement tests is still a source of controversy with each college or university defending its particular position vehemently (Akst & Hirsch, 1991).

The Problem

Given a shrinking student base and the demographic changes in the make-up of that base, only three ways of maintaining enrollment are available: (1) increase the proportion of students from the traditional pool who make the decision to attend college; (2) pursue those student populations considered nontraditional (older, non-Anglo, etc.); (3) increase retention. This last approach has proven historically to be least successful. Past success with the first two methods of maintaining enrollment has created an illusion that such efforts are the most productive and should be continued into the future. However, studies have already shown that reliance on these methods alone will leave an institution vulnerable to the effects of declining enrollments. The obvious solution is a rededication of retention efforts and the development of a comprehensive strategy that includes both systematic recruiting and well-entrenched retention strategies (Porter, 1990).

Tinto argued that the key to retention lies not only with specific retention strategies but also with the development of a commitment to the educational process as a whole. Institutions with effective retention programs focus on the communal nature of college life along with a strong commitment to the students; in order to accomplish this, institutions must clarify their educational mission and guard against incongruence between what the individual needs and what the institution is providing (Tinto, 1987b). Questions regarding the institution's ability to promote educational opportunity through the training of underprepared students must be answered. Furthermore, issues regarding program efficiency must be addressed; will the institution be able to retain significantly greater numbers of students who might otherwise have been lost? (Boylan, 1983). The retention of potentially successful students makes more sense in terms of efficiency than to have to try to recruit new admissions from an increasingly diminished pool (Boylan, 1983).

The general consensus in the literature defines the mission of the field of developmental education as the promotion of educational opportunity for the underprepared college student, the promotion of academic excellence for all college students, and the promotion of

academic efficiency through the retention of potentially successful students. This mission incorporates both developmental (developing diverse talents) and remedial (overcoming deficiencies) issues (Boylan, 1983). Thus, any measurement of the effectiveness of a developmental program requires documentation of its contribution to overall student retention (Boylan, 1983). One such measurement addressed in this study was the ability of faculty and advisors to provide appropriate instruction and guidance to students deemed to be at-risk; early intervention strategies must be implemented if these students are to have a chance of success.

When developmental coursework is considered as a factor in the retention analysis, grade distributions for former developmental students seem to compare favorably with overall grade distributions from English and math college level courses (Hector, 1983). For those enrolled in developmental math courses, a strong relationship exists between grades earned in those courses and persistence (Kolzow, 1986). The identification of such factors that can be used to predict student success will assist faculty in developing curricula and teaching methods, advisors in counseling students, and administrators in their efforts to sustain the mission of the institution. Appropriate intervention efforts on behalf of faculty and advisors can then begin at an early phase in the student's academic career and may be more likely to bring about constructive change in their academic progress and sustain retention efforts. (Frerichs & Eversveld, 1981).

The Study

This particular study was concerned with student success in developmental math at Northwestern State University. While all developmental courses are a source of concern for universities, math, typically, has been viewed as the one in which more students experience difficulty. The goal was to determine whether or not three groups of developmental math students (completers, nonsuccessful completers, and noncompleters) were significantly different in terms of dropout proneness scores on the College Student Inventory.

Incoming freshmen are placed in math classes on the basis of either ACT or SAT scores or math placement exam scores. Those with an ACT of 18 or lower (SAT below 450) are placed into developmental math; those without an ACT score on file or who believe that the ACT does not adequately reflect their ability may take the math placement exam. A score of 75% or higher is required for placement in college algebra.

The sample for the study was drawn from students who were enrolled in Math 0920 (developmental math) during the Fall 1996 semester. This semester was selected for study because it was the first semester that students in the math classes were given the College Student Inventory; only those students who took the College Student Inventory were included in the sample. Demographic information for these students was available from the Student Information System as well as the Retention Management System used for tracking entering freshmen.

The College Student Inventory was designed for use with incoming freshmen. It consists of 194 items contained in 19 scales which are organized into five main categories: academic motivation, social motivation, general coping skills, receptivity to support

services, and initial impression; some demographic and background data is also included. The dropout proneness scale measures the student's overall inclination to drop out of school prior to the completion of a degree plan. It was developed empirically by comparing students who stayed in school after their first term with those who did not. The pattern of intellectual and academic motivational traits associated with dropping out is more pronounced in those with high scores but the score itself is not considered to be an absolute predictor. This inventory was administered to entering freshmen during the Freshman Connection sessions held during the summer or at the beginning of the fall semester (during orientation classes).

Course grades for students were obtained from the Student Information System; course grades of "A," "B," "C," "D," "F" or "W" were used to classify students as successful completers (those with a grade of "C" or better), nonsuccessful completers (those with a grade of "D" or "F") and noncompleters (those with a grade of "W"); information from instructors permitted classification of noncompleters to include those who simply stopped attending class. Overall GPA and number of hours pursued was collected from the Student Information System.

Of the 684 students enrolled in developmental math that semester, 402 fit the criteria specified. Of the 282 who did not meet the criteria, 67 were repeating the course, 204 were not first semester freshmen, and the remaining 11 did not have College Student Inventory results on file. These 402 students were assigned to groups (successful completer, nonsuccessful completer and noncompleter) on the basis of their final grade in the course. Those who received a grade of "A", "B", or "C" were classified as successful completers (n=251); those who received a grade of "D" or "F" were classified as a nonsuccessful completer (n=89). Finally, those receiving a grade of "W" were classified as noncompleters (n=62). Scores on the various components of the College Student Inventory were recorded for each student.

The goal of the study was to determine whether or not the three groups (completers, nonsuccessful completers, and noncompleters) were significantly different in terms of dropout proneness scores on the College Student Inventory.

Results

Results of ANOVA illustrated in Table 1 indicate that statistically significant differences existed among the groups.

Table 1 Analysis of Variance of Dropout Proneness Scores

		Sum of Squares	df	Mean Square	F	Sig.
Dropout Proneness	Between Groups	50.46	2	25.23	5.97	$p<.01$
	Within Groups	1686.91	399	4.23		
	Total	1737.37	401			

In order to identify where the differences lie, post hoc testing was done using Tukey's comparison procedures, as shown in Table 2. When the number of comparisons to be made is large, SPSS recommends the use of this procedure as it is more sensitive in detecting differences (SPSS, 1997).

Table 2
Multiple Comparisons on Dropout Proneness Using Tukey's HSD

(I) Group	(J) Group	Mean Diff (I-J)	Std. Error	Sig.
Successful Completer	Nonsuccessful Completer	-.87*	.25	p<.01
	Noncompleter	-.38	.29	.39
Nonsuccessful Completer	Successful Completer	.87*	.25	p<.01
	Noncompleter	.49	.34	.33
Noncompleter	Successful Completer	.38	.29	.39
	Nonsuccessful Completer	-.49	.34	.33

*The mean difference is significant at the .05 level.

Significant differences were found between successful completers and nonsuccessful completers on dropout proneness score using Tukey's multiple comparisons technique. Nonsuccessful completers had higher dropout proneness scores than successful completers. No statistically significant differences were found between noncompleters and successful completers or between noncompleters and nonsuccessful completers. The fact that the scores of the nonsuccessful completers were not significant in the model may stem from the reasons that they had for dropping out.

Conclusions

As long as the university continues its open admission policy, there is little reason to believe that the number of high-risk students admitted will change significantly. Demand for developmental math has remained fairly consistent over the past 10 years despite changes in the placement process during that time. The students entering the university simply lack the basic skills identified as essential for success in college algebra.

The study findings also suggest that use of the College Student Inventory as a predictor of success in developmental math is not practical from an administrative viewpoint; the cost/benefit ratio is simply prohibitive. The College Student Inventory is highly predictive of student success when that success is defined in terms of first-year college GPA (Noel Levitz, 1993). While the attitudinal and motivational factors included in this instrument may be useful for determining risk in terms of overall performance, its usefulness in predicting success in developmental math is limited. Although th

study focused on developmental math, the factors associated most closely with success were actually more global measures of overall success in college. Considering the strong relationship between success in developmental math and subsequent college-level work, this is not surprising (Seybert & Soltz, 1992). The implication can be drawn that the skills (such as problem solving and critical thinking) taught in the developmental math classes serve the student well throughout his/her college career. Success in developmental math, then, has a direct impact upon retention (Boughan, 1995).

When scores on the dropout proneness scale are incorporated into the overall assessment, faculty and advisors can better assess the students' needs and make more appropriate referrals for assistance. Higher dropout proneness scores were associated with lack of success in developmental math.

Recommendations

Improvements in current developmental math courses. Given the open admission policy at the university, any philosophical debate regarding the admission of high-risk students is moot. These students are being admitted and the university must carefully consider its responsibility to the students enrolled in a developmental math course. According to Burley (1994), courses that rest upon a strong theoretical base are superior to those that are simplistic versions of a regular college course. In other words, watered-down versions of college courses do not produce the same results as a carefully considered instructional base. Accordingly, the university should continue to allow the math department to maintain control of the developmental math course rather than placing it within a developmental education framework. The math faculty have already demonstrated their commitment to excellence in math education and have worked diligently to implement the National Council of Teachers of Mathematics (NCTM) standards into all math classes taught at Northwestern State University. These guidelines include both curriculum development and use of technology in the classroom. Based upon departmental research, the results in the college algebra classes have been excellent (personal communication, Dr. Ben Rushing, October 1997). These changes are currently being implemented within the developmental classes and should be allowed to continue.

Improvements in pre-college preparation for math. According to Payne (1992), very little research has been conducted on math readiness for college. His findings that a senior level math class and/or participation in a math readiness program was significantly related to college math readiness suggest that high schools play an important role in preparing students for college. When math readiness is emphasized at that point, students enter college with a much better chance of succeeding. This is also supported by a study done by the Florida State Committee on Higher Education and the Commission on Education (1996). They found that the completion of Algebra I, Geometry, and Algebra II significantly reduced the need for developmental math at the college level. The public supports the need for greater emphasis upon the development of mathematical ability; four years of mathematics, even for those not planning to attend college is the recommended norm. Unfortunately, this standard exceeds even the most stringent of high school graduation requirements for any state and even exceeds the admission requirement of all but a few of

the most selective colleges and universities (A Nation at Risk, 1983). Given these factors, more emphasis must be placed on mathematical skills at the high school level especially with regard to content standards, curriculum standards, assessment standards, and evaluation standards (Steen, 1995).

Based upon the study findings, steps should be taken on a statewide level to ensure that students, whether college-bound or not, are required to take a more comprehensive sequence of math courses. Math skills are essential for success in today's society; students who are unable to perform simple calculations, such as taking a discount or determining loan payments, will find themselves at a competitive disadvantage.

Furthermore, the content of the current courses as well as assessment and evaluation standards should be closely examined. If students are satisfactorily completing a college preparatory sequence of math courses and still require remediation at the college level, serious questions exist (Bershinsky, 1993). Open dialogue must be maintained between faculty and high school math teachers to ensure that expectations of student competency are clearly understood. In addition, initiatives should be continued and encouraged to promote consistent high-quality math instruction.

Early intervention for success in developmental math. Knowing that the students with high dropout proneness scores are more likely to be unsuccessful overall, early intervention is essential. This is especially true for students enrolled in developmental math classes; these students face the greatest chance of failure (when compared to those enrolled in other types of developmental classes) (Boughan, 1995). The study confirms this as the non-successful completers had higher dropout proneness scores than the successful completers. Mathematical ability and confidence has been shown to make a difference in educational decisions; those who feel confident about their ability to handle mathematical concepts are more likely to remain in school (Hertz, 1993).

Instructors and advisors should monitor students deemed to be high risk for dropping or failing developmental math. Subtle clues are usually manifested at an early stage when appropriate intervention strategies can be implemented. Students who frequently miss class or fail to complete assignments should be steered toward support services on campus that are tailored to meet their needs. Northwestern already has a peer tutoring system in place as well as the PASS program; advisors should be encouraged to refer students enrolled in developmental math to these programs early in the semester in order to enhance their potential for success. In addition, students may be referred to study skills seminars, time/stress management seminars or for career counseling.

Further research. Further empirical research should be considered regarding the noncompleter group. The survey conducted by Northwestern does not present a complete picture. These students may actually exhibit the characteristics associated with success in college; appropriate intervention efforts (which may include alternative instructional delivery) should be made in order to try to retain these students.

An evaluation plan should be developed for the developmental math course. Questions as to the success of these students in college

algebra remain unanswered. Are these students performing as well in subsequent math classes as their cohorts who did not take developmental math? Tracking these students through the system will provide better direction for future changes to the developmental math course.

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